AMENDMENTS TO THE CLAIMS

1. (Currently amended) A position measuring device usable for measuring a relative position between two members, the position measuring device comprising:

an imaging array detector; and

a structured light generating target member comprising at least three respective target sources that output at least three respective structured light patterns, the output structured light patterns being in a fixed relationship relative to the target member,

wherein:

the imaging array detector and the structured light generating target member are positionable to provide [[an]] a structured light image on the imaging array detector ~~that corresponds to a structured light pattern generated by at least a portion of the structured light generating target member~~;

each of the at least three respective target sources gives rise to a corresponding respective image feature in the image on the imaging array detector; and

~~the image on the array detector is usable to determine at least one measurement value that corresponds to at least one degree of freedom of the relative position between the imaging detector and the target member~~ a size characteristic of each of the at least three corresponding respective image features in the image is usable to determine a z-coordinate value for a respective reference point that is fixed relative to the corresponding respective target source, the z-coordinate value corresponding to a translational degree of freedom along a z-axis that extends along a direction of varying separation between the imaging array detector and the target member.

2. (New) The position measuring device of Claim 1, wherein:

LAW OFFICES OF
CHRISTENSEN O'CONNOR JOHNSON KINDNESS^PLLC
1420 Fifth Avenue
Suite 2800
Seattle, Washington 98101

the locations of a plurality of the corresponding respective image features in the image are usable in conjunction with their respective size characteristics to determine (x,y,z) coordinate values for the corresponding respective target sources, wherein the x-coordinate value and the y-coordinate value correspond to two translational degrees of freedom in a plane that is perpendicular to the z-axis.

3. (New) The position measuring device of Claim 2, further comprising a signal processing unit configured to input and analyze at least one structured light image, determine the respective size characteristics and locations of the plurality of the corresponding respective image features in the image, determine the (x,y,z) coordinate values for the corresponding respective target sources; and determine a six degree of freedom relative position between the imaging detector and the target member based on the determined (x,y,z) coordinate values.

4. (New) The position measuring device of Claim 3, wherein:

a plurality of respective target sources are each configured such that they each give rise to a corresponding respective image feature comprising a respective elliptical pattern in the image when a plane of the target member is not parallel to a plane of the imaging array detector;

the signal processing unit is configured to fit respective ellipses to respective elliptical patterns,

the determined respective size characteristics comprise the dimensions of the major and minor axes of the respective ellipses fit to respective elliptical patterns; and

the determined respective locations comprise the center of the respective ellipses fit to respective elliptical patterns.

5. (New) The position measuring device of Claim 4, wherein each respective elliptical pattern in the image exhibits a set of radial intensity profiles, each radial intensity

LAW OFFICES OF
CHRISTENSEN O'CONNOR JOHNSON KINDNESS^PLLC
1420 Fifth Avenue
Suite 2800
Seattle, Washington 98101

profile comprising the intensity values of a set of image pixels of the elliptical pattern lying along one corresponding radial direction extending from a nominal center of the respective elliptical pattern, and the signal processing unit is configured to:

determine the location of a radial intensity profile peak for each member of the set of radial intensity profiles corresponding to a respective elliptical pattern; and

fit a respective ellipse to the determined locations of the radial intensity profile peaks corresponding to that respective elliptical pattern.

6. (New) The position measuring device of Claim 2, wherein the structured light generating target member comprises a two-dimensional array of respective target sources that output respective structured light patterns, and the two-dimensional array of respective target sources is periodic along each of two directions.

7. (New) The position measuring device of Claim 1, wherein a plurality of the respective target sources are configured such that each of their respective image features comprise at least one of a ring-shaped pattern that is continuous in the image and a ring-shaped pattern that consists of a group of discrete light spots in the image.

8. (New) The position measuring device of claim 7, wherein the ring-shaped pattern is an elliptical pattern when a plane of the target member is not parallel to a plane of the imaging array detector.

9. (New) The position measuring device of Claim 8, wherein the plurality of the respective target sources are configured such that the dimension of each ellipse-shaped pattern across its minor axis is linearly related to the z-coordinate value corresponding to the respective target source that gives rise to the ellipse in the image.

LAW OFFICES OF
CHRISTENSEN O'CONNOR JOHNSON KINDNESS^PLLC
1420 Fifth Avenue
Suite 2800
Seattle, Washington 98101

10. (New) The position measuring device of Claim 8, wherein a plurality of respective target sources each comprise an optical element that has an optical axis, and that inputs collimated light from a light source parallel to its optical axis, and outputs a respective structured light pattern.

11. (New) The position measuring device of Claim 10, wherein the optical element outputs a structured light pattern comprising rays distributed in a pattern that nominally coincides with at least of part of a conical surface of revolution, the structured light pattern having a cross-section that forms a ring-shaped pattern in a plane perpendicular to the optical axis, and wherein the rays each form approximately the same cone angle relative the optical axis.

12. (New) The position measuring device of Claim 11, wherein the optical element comprises at least one of a refractive axicon lens, a refractive faceted pyramidal lens, a ring-shaped lens having a prismatic cross-section, a diffractive optical element that provides the effect of a refractive axicon lens, a diffractive optical element that provides the effect of a refractive faceted pyramidal lens, and a diffractive optical element that provides the effect of a ring-shaped lens having a prismatic cross-section.

13. (New) A method for measuring a relative position between two members, the method comprising:

providing an imaging detector;

providing a structured light generating target member comprising at least three respective target sources that output at least three respective structured light patterns, the output structured light patterns being in a fixed relationship relative to the target member;

positioning the imaging array detector and the structured light generating target member to provide a structured light image on the imaging array detector;

LAW OFFICES OF
CHRISTENSEN O'CONNOR JOHNSON KINDNESS^PLLC
1420 Fifth Avenue
Suite 2800
Seattle, Washington 98101

providing an image on the imaging array detector, wherein each of the at least three respective target sources gives rise to a corresponding respective image feature in the image; and

for each of the at least three corresponding respective image features in the image, determining a size characteristic of that respective image feature and using the size characteristic to determine a z-coordinate value for a respective reference point that is fixed relative to the corresponding respective target source, each z-coordinate value corresponding to a translational degree of freedom along a z-axis that extends along a direction of varying separation between the imaging array detector and the target member.

14. (New) The method of Claim 13, the method further comprising:

determining the locations of a plurality of the corresponding respective image features in the image; and

using the determined locations of the plurality of the corresponding respective image features in the image, in conjunction with their respective size characteristics, to determine (x,y,z) coordinate values for the corresponding respective target sources, wherein the x-coordinate value and the y-coordinate value correspond to two translational degrees of freedom in a plane that is perpendicular to the z-axis.

15. (New) The method of Claim 14, the method further comprising:

determining a six degree of freedom relative position between the imaging detector and the target member based on the determined (x,y,z) coordinate values.

16. (New) The method of Claim 14, wherein:

a plurality of respective target sources are each configured such that they each give rise to a corresponding respective image feature comprising a respective elliptical pattern in the image when a plane of the target member is not parallel to a plane of the imaging array detector;

LAW OFFICES OF
CHRISTENSEN O'CONNOR JOHNSON KINDNESS^PLLC
1420 Fifth Avenue
Suite 2800
Seattle, Washington 98101

determining a size characteristic and location of a respective image feature in the image comprises fitting respective ellipses to its respective elliptical patterns; and

the determined respective size characteristics comprise the dimensions of the major and minor axes of the respective ellipses fit to respective elliptical patterns, and the determined respective locations comprise the center of the respective ellipses fit to respective elliptical patterns.

17. (New) The method of Claim 14, wherein each respective elliptical pattern in the image exhibits a set of radial intensity profiles, each radial intensity profile comprising the intensity values of a set of image pixels of the elliptical pattern lying along one corresponding radial direction extending from a nominal center of the respective elliptical pattern, and fitting a respective ellipses to its respective elliptical pattern comprises:

determining the location of a radial intensity profile peak for each member of the set of radial intensity profiles corresponding to a respective elliptical pattern; and

fitting a respective ellipse to the determined locations of the radial intensity profile peaks corresponding to that respective elliptical pattern.

LAW OFFICES OF
CHRISTENSEN O'CONNOR JOHNSON KINDNESS^PLLC
1420 Fifth Avenue
Suite 2800
Seattle, Washington 98101